March 26, 1946. H. E. SOMES 2,397,442

HEATING HEAD

Filed Dec. 30, 1943

Fig. 1.

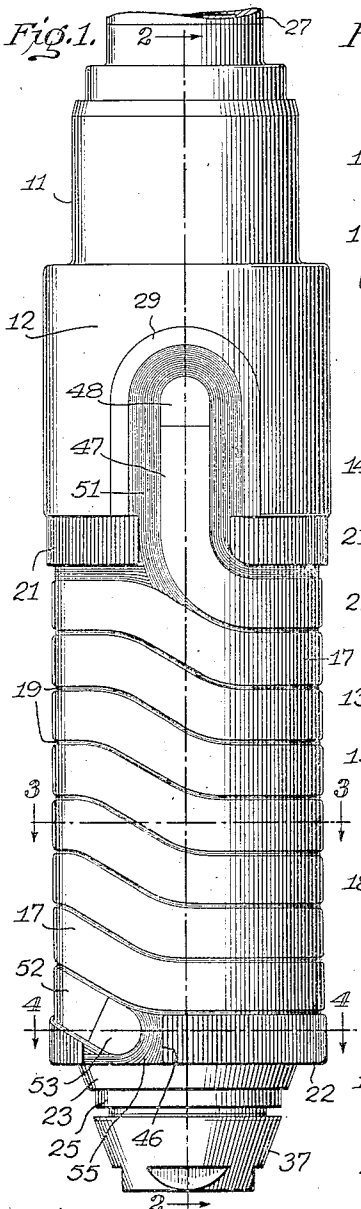


Fig. 2.

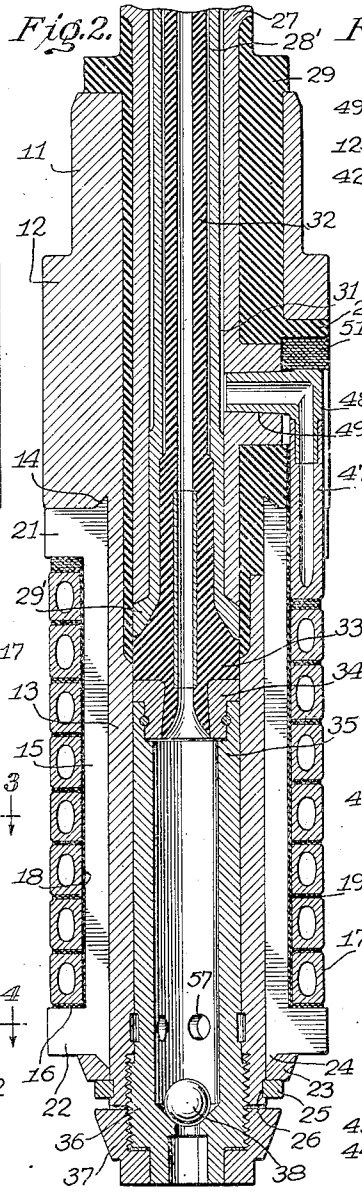


Fig. 6.

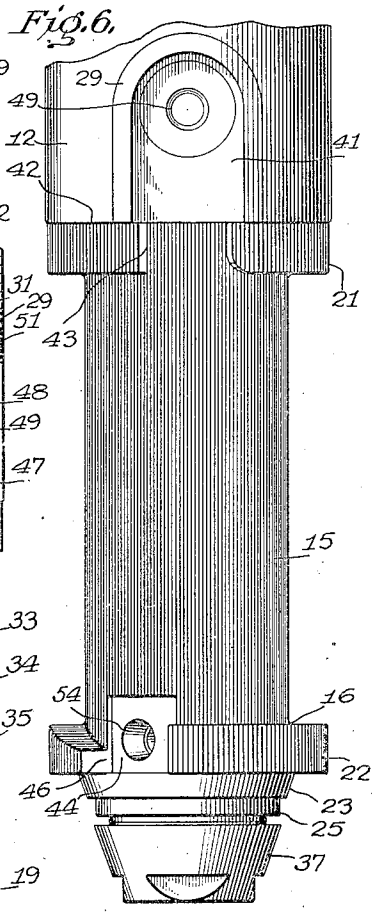


Fig. 3.

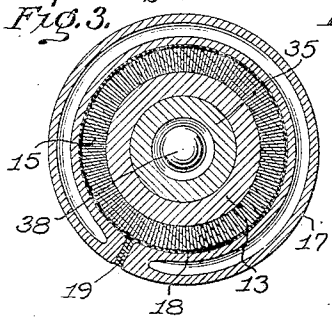


Fig. 4.

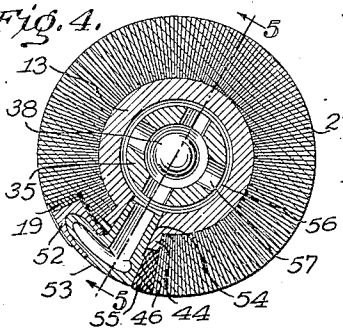
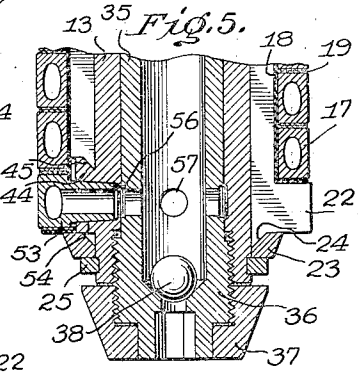


Fig. 5.



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HEATING HEAD

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Application December 30, 1943, Serial No. 516,182

5 Claims. (Cl. 219—13)

This invention relates to the construction of heating heads such as are employed in heat treating metallic articles of various types by electromagnetic induction.

Such heating heads, particularly when employed for inducing electromagnetic heating currents within the inner walls of hollow articles, usually comprise an inductor coil wound on and supported by a magnetic core which is so formed as to constitute together with the workpiece a predetermined path for the magnetic flux of the heating coil. The core usually has a recess in which the coil is wound and is provided with outwardly projecting annular pole pieces at each side of the recess adjacent each end turn of the coil. Current is supplied to the core by means of arbor and mandrel conducting members on which the core and coil are supported and to which the coil terminals are electrically connected. For this purpose it has been customary to cut away a part of the laminated core and insert a block of insulation in the cutaway portion, one or more of the electrical connections of the coil being carried through such block of insulation. This requires an interruption in the core material which breaks the continuity of the flux path.

An object of this invention is to provide an improved induction heating head constructed and arranged to provide insulated connections for the coil terminals to the conducting and supporting arbor and mandrel members without requiring any interruption in the continuity of the magnetic core.

A further object is to provide an electromagnetic induction heating head for heating the internal surfaces of annular objects of increased efficiency.

These and other objects are accomplished by the invention herein described and illustrated in the accompanying drawing in which:

Fig. 1 is a side elevation of an induction heating head constructed in accordance with one embodiment of this invention;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1.

Figs. 3 and 4 are transverse sections on the lines 3—3 and 4—4 of Fig. 1, respectively;

Fig. 5 is a section on the line 5—5 of Fig. 4, and

Fig. 6 is an elevation of the head shown in Fig. 1 with the heating coil removed for the purpose of more clearly illustrating the arrangement of the laminated core.

As illustrated, the invention comprises a mandrel 11 having a relatively large head 12 and stem 13 of reduced diameter having a dovetailed annular groove 14 in the upper end of the stem portion for receiving the dovetailed ends of radially tapered laminations 15 forming a magnetic core having a circumferential recess 16 for receiving the current conducting tubular coil 17 of the usual construction. A layer of insulation 18 is provided between the coil and the supporting bore, and additional insulation 19 is positioned between the individual turns of the coil to insulate the individual turns from each other. For the greater part, the laminations are formed with pole pieces 21 and 22 at the top and bottom of the circumferential recess 16. The laminations are held in place on the arbor stem 13 by a washer 23 formed to accommodate the dovetailed ends 24 at the bottoms of the laminations. The split ring 25 fitting within a groove 26 in the mandrel stem secures the laminations and coil in place.

An annular, current-conducting arbor member 27 extends downwardly into the mandrel 11 from which it is insulated by an annular tube 29 of insulating material surrounding the arbor member and extending downwardly below the end thereof. A tubular supporting member 28' has a head 29' engaging the lower end of the arbor member, and the outer diameter of the tube is reduced to provide a fluid channel 31 between the arbor member and the tubular supporting member. An inner tube 32 of insulating material is positioned within the tubular member 28' and has a head 33 vulcanized or otherwise secured to an annular ring 34 rotatably keyed to a valve sleeve 35 having a threaded lower end 36 threaded to the inner end of the mandrel stem 13. A fitting 37 is threaded to the projecting end of the valve sleeve 35 to lock the parts together. A ball valve 38 is provided at the lower end of the valve sleeve 35.

Heretofore, as above pointed out, the opposite ends of the heating coil 17 have been connected to the arbor and mandrel members, respectively, by connectors extending inwardly through the laminated core 15. For this purpose, portions of the core have been cut away with insulating blocks inserted in place through which the connectors extend. This arrangement has, of course, broken the continuity of the flux path provided by the core. In the present invention, the disadvantages of this arrangement are overcome and a continuous core and resulting continuous flux path are provided throughout the annulus of the coil. As illustrated, the mandrel head 12 is formed with a pocket 41 opening through the face and lower edge 42 thereof, and the pole piece 21 of the core is cut away to form a slot 43 communicating with the pocket 41.

Adjacent the lower end of the core, the mandrel stem 13 is formed with a rectangular lug 44, see Figs. 4, 5, and 6, which extends radially outwardly and is provided with a dovetailed groove 45 in its upper face for receiving the dove-

tailed projections on the lower ends of the laminations forming the core above the lug. The laminations forming the lower pole piece 22 are cut away to provide a slot 46 in front of the lug 44.

The upper end 47 of the coil 17 is bent to extend through the pole piece slot 43 into the mandrel pocket 41 and a hollow angular connector 48 has one end secured to the end of the coil and the other fitted in a socket 49 formed in the adjacent wall of the arbor member 27. The pocket 41 is of such size that insulation 51 can be positioned around the coil and 47 and connector 48 to insulate them from the mandrel head 12, thus forming an insulated electrical connection between the upper end of the coil and the arbor member 27.

The lower end 52 of the coil 17 extends into the slot 46 in the lower pole piece 22, and is connected to the mandrel member by a connector 53 secured to the coil end and also fitted within the socket 54 of the lug 44. The slot 46 in the lower pole piece 22 is of such size that insulation 55, see Fig. 1, can be inserted around the fitting to insulate it from the pole piece.

It will be understood that a suitable coolant is circulated through the coil 17, being delivered thereto through the water passage 31 formed between the arbor 27 and the tubular member 28', thence through the hollow fitting 49 and inductor coil. After passing through the coil coolant flows through the hollow fitting 53 at the lower end of the coil, through a circumferential passage 56 in the adjacent face of the mandrel stem 13, and openings 57, see Figs. 2, 4, and 5, and upwardly through the interior of the valve sleeve 36. When the ball valve 38 is closed, the coolant flows upwardly through the hollow insulating tube 32. When the ball valve 38 is opened, as is usually the case during a heating operation, the coolant can also escape downwardly through the lower end of the head.

It will be apparent that the present invention provides a heating head in which the annular core is complete for the entire 360°, with the result that the flux path provided by the core is complete for the entire 360°. Obviously, the invention can be variously modified and adapted within the scope of the appended claims:

What is claimed is:

1. The combination in an induction heating head, of a hollow supporting current-conducting mandrel, a head on said mandrel having a pocket formed in the face thereof and opening through one side, a current-conducting arbor located within said mandrel, a magnetic core mounted on and entirely surrounding said mandrel adjacent said head, an inductor coil surrounding said core and having one end extending into said pocket, means electrically connecting said coil end to said arbor, and means insulating said coil end from said mandrel.

2. The combination in an induction heating head, of a hollow supporting current conducting mandrel, a head on said mandrel having a pocket formed in the face thereof and opening through one side, a current conducting arbor located within said mandrel, a magnetic core supported on said mandrel having spaced annular slotted pole pieces separated by an intervening recess, an inductor coil located in said recess having one end extending through the slot of one pole piece into said pocket, means electrically connecting said coil end to said arbor, means insulating said coil end from said mandrel, the other end of said coil extending through the slot of the other pole piece and electrically connected to said mandrel member.

3. In an induction heating head, a first annular current-conducting member having an opening through the wall thereof, a second current-conducting member having a portion disposed within said annular member, means electrically insulating said members from each other, a magnetic core entirely surrounding said first current-conducting member and having radial pole pieces, said core being axially spaced from said opening, each of said pole pieces having a longitudinal slot therein, a helical conductor disposed on said core between said pole pieces and insulated therefrom and having its ends disposed within said slots, one of said conductor ends extending longitudinally beyond the adjacent pole piece, insulated from said annular conductor and electrically connected through said opening with said second conductor, the other of said conductor ends being electrically connected with said annular member.

4. In an induction heating head, a first current conductor having a core-supporting portion and a coaxial portion of greater diameter forming a radial shoulder with said core-supporting portion, at least said coaxial portion being annular in cross-section and having a longitudinal recess in its outer face opening through said shoulder and an aperture through its annular wall opening into said recess, a second current conductor disposed within said portion of greater diameter in overlapping relation with said aperture, a magnetic core completely surrounding said core-supporting portion with one end in abutting engagement with said shoulder, core-retaining means secured to said core-supporting portion and abutting the other end of said core, a helical conductor surrounding said core and having one end electrically connected with said first conductor and its other end extending longitudinally into said recess, an electrical connection within said aperture between said last-mentioned coil end and said second conductor, and electrical insulation means insulating said conductors from each other and said last-mentioned coil end from said first current conductor.

5. In an induction heating head, inner and outer concentric conductors, said outer conductor having an aperture in its wall and said inner connector having a terminal portion aligned with said aperture, said outer conductor having a radial shoulder and a recess in its outer surface including said aperture and opening through said shoulder, a magnetic core carried by said outer conductor and having a radial pole piece abutting said shoulder, said pole piece having a through-slot aligned with said recess, a helical inducing conductor carried by and insulated from said core, one end of said helical conductor being disposed in said slot and recess and having an electrical connection through said aperture with said terminal portion, the other end of said helical conductor being electrically connected with said outer conductor, and electrical insulation insulating said conductors from each other and said first-mentioned coil end from said pole piece and outer conductor.

HOWARD E. SOMES.